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13. ABSTRACT (Maximum 200 words)

Analysis of equatorial observations of GPS from stations on the magnetic equator and in the anomaly region allow us to begin to study the morphology of height of plumes and the occurrence pattern of thin layers of irregularities during years of low solar flux. Very high altitude plumes have been observed during magnetic storms in the data sets analyzed for 1993-1996. At high latitudes a storm expands the irregularity oval moving the irregularity regions producing scintillation and phase fluctuations to lower latitudes and to polar latitudes.

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for

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THE EFFECTS OF MAGNETIC STORM PHASES ON F-LAYER IRREGULARITIES FROM AURORAL TO EQUATORIAL LATITUDES

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A. RESEARCH PAPERS

In this quarter, this grant's studies were divided between high latitude and equatorial region studies. Two papers on these subjects were submitted for publication to the Proceedings of the Ionospheric Effects Symposium of 1996

High Latitude GPS Observations and Receiver Constraints by J. Clynch, Naval PostGraduate School and J. Aarons, Boston University

GPS Phase Fluctuations in the Equatorial Region J. Aarons, M. Mendillo, and R. Yantosca

B. GPS PHASE FLUCTUATIONS AT AURORAL LATITUDES DURING MAGNETIC STORMS

J. Aarons, M. Mendillo, R. Yantosca Center for Space Physics Boston University Boston, MA 02215

A draft of studies involving predominantly auroral latitudes has been completed. The data indicate the domination of the irregularity oval in the timing of irregularity appearance. Even during magnetic storms the entry and exit of the station into the auroral oval dominates although the magnetic storm essentially modulates the pattern.

ABSTRACT

Using simultaneous observations of the GPS satellites from several high latitude stations it was possible to determine the behavior pattern for the development of phase fluctuations in the auroral and sub-auroral irregularity regions. Starting with characteristics of the irregularity development in magnetically quiet days, it was noted that the start and stop times of phase fluctuations correlated with the entry and exit into the irregularity oval. The duration of phase fluctuations during quiet days was a function of how close the station was to the oval. Maximum occurrence took place near magnetic midnight. The irregularity oval while matching the auroral oval in much of its behavior receded to very high latitudes during extended periods of magnetic quiet. The irregularity oval can be developed in terms of intensity whereas the auroral oval optically is only of occurrence.

During magnetic storms the irregularity oval expands equatorwards and polewards and phase fluctuations increase in intensity. While the geographic position of the station relevant to the oval is important during storms, the dynamics of each storm modifies the simple behavior shown during quiet times.

It was not possible to determine the altitude of the irregularities for the group of magnetic storms analyzed in this paper. Magnetic activity increases the number flux of both soft and hard electrons with the former precipitating at F layer altitudes and the latter at E layer altitudes. The phase fluctuation data are of total irregularity intensity. Recent studies have stressed E layer dominance. However the long studies of spread F using ionosondes and the flux increase of soft electrons as well as hard electrons during magnetic storms makes it difficult to evaluate the contributions of the F layer. Earlier studies have indicated that both E layer aurora and F layer irregularities frequently appear simultaneously during both quiet and disturbed periods. The

thickness of the F layer irregularity region may cause that region to dominate in contributions to irregularities when E and F layer critical frequencies are close (which has been shown in some studies of auroral activity).

C. FUTURE STUDY; INTERRELATIONSHIP OF HIGH LATITUDE AND EQUATORIAL IRREGULARITY DEVELOPMENT

Data sets similar to those cited will be used to study the effect of high latitude magnetic variations and high latitude phase fluctuations on the developments of plumes at the equator. At the equator, it is the generation of neutral winds that is presently thought to be the dominating storms effects on the generation or inhibition of equatorial plume structure for equatorial latitudes in all likelihood requires the use of several magnetic parameters and will include localized effects.

If magnetic data in detail correlates with scintillation, then forecasting will be available if we know the right parameters to put into the model. If this proves to be the case, the study of the relationship of magnetic observations and high latitude development of irregularities would be of great assistance in forecasting scintillations at the equator.